wherein a residence time τ of the fluorocarbon gas is controlled at 0.1 sec or less, the residence time τ being given by PxV/Q, where P is a pressure (unit: Pa) of the fluorocarbon gas, V is a volume (unit: L) of the reaction chamber and Q is a flow rate (unit: Pa · L/sec) of the fluorocarbon gas.

10. (Amended) A plasma processing method comprising the steps of:

placing a substrate inside a reaction chamber of a plasma processing system;

introducing a fluorocarbon gas into the reaction chamber, wherein the fluorocarbon gas contains at least one of C_4F_6, C_5F_8, and C_6F_6 gases; and

creating a plasma from the fluorocarbon gas and depositing an organic film on the substrate using the plasma,

wherein PxW_0/Q is controlled at $0.8x10^4$ sec · W/m^3 or less, PxW_0/Q being a product of a residence time τ of the fluorocarbon gas and a power density of Pi of power applied to create the plasma, the residence time τ being given by PxV/Q, where P is a pressure (unit: Pa) of the fluorocarbon gas, V is a volume (unit: L) of the reaction chamber and Q is a flow rate (unit: Pa·L/sec) of the fluorocarbon gas, the power density Pi being given W_0/V, where W_0 is a magnitude (unit: W) of the power and V is the volume (unit: L) of the reaction chamber.

REMARKS

The Examiner's Office Action of January 30, 2002 has been received and carefully reviewed. By this amendment claims 1, 4, 7, and 10 have been amended and claims 2, 5, 8, 11, and 13-18 have been canceled. Claims 1, 3, 4, 6, 7, 9, 10 (12) are now pending.

The Examiner has rejected claims 1-6 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,595,627 to Inazawa et al. (hereinafter "Inazawa et al"). In formulating his rejection, the Examiner provides that "Inazawa et al disclose a plasma etching process, wherein a silicon dioxide layer is etched over a substrate using fluorocarbon gas such as C_4F_8, the carbon to fluorine ratio is 0.5 (col. 6, lines 44-54)." (See Office Action, page 2). Contrary to the Examiner's assertion, however, Inazawa et al. do not teach nor suggest, either explicitly or inherently, the applicability of their disclosed invention with any fluorocarbon gas other than C_4F_8. According to Inazawa et al the use of C_4F_8 is not exemplary, but is inherently mandated.

Claims 1, 3, 4, and 6 are herein amended to recite only C_4F_6, C_5F_6, and C_6F_6, i.e., fluorocarbons gases with a ratio of carbon to chlorine of less than 0.5. To establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Since Inazawa do not teach or suggest the use of C_4F_6, C_5F_6, and C_6F_6 the rejection of claims 1, 3, 4, 6, is now improper and should be withdrawn.

The Examiner has also rejected claims 7-9 under 35 U.S.C. 103(a) as being unpatentable over U.S. patent No. 5,244,730) to Nguyen et al (hereinafter "the '730 patent). Claim 7 has likewise been amended to recite the use of fluorocarbons, namely, C_4F_6, C_5F_6, and C_6F_6 which are not taught nor suggested by the '730 patent. Claim 8 has been deleted and claim 9 remain dependent on claim 7. Therefore, for the same reasons discussed above with respect to claims 7 and 9, it is respectfully submitted that the Examiner's rejection should be reconsidered and withdrawn.

The Examiner rejected claims 10-12 under 35 U.S.C. 103(a) as being unpatentable over U.S patent No. 5,585,627 to Nguyen et al (hereinafter "the '627 patent). Claim 11 has been deleted and claim 12 remains dependent on claim 10. Therefore, for the same reasons discussed above with respect to claims 1, 3, 4, 6, 7, and 9, the rejection of claims 10 and 12 should also be reconsidered and withdrawn.

Claims 2, 5, 8, 11, 14, and 17 are further rejected under 35 U.S.C. 112, second paragraph on the basis that it is not clear how the carbon to fluorine ratio is 0.5 or more in the gas C_3F_8 because the carbon to fluorine ratio for the gas is only 0.375. By the present amendment these claims are deleted from the application; therefore, the Examiner's rejection of these claims under 35 U.S.C. 112, second paragraph is now moot and should be withdrawn.

In view of the foregoing, it is respectfully submitted that the application should now be in condition for allowance. An early Notice of Allowance is courteously solicited.

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MARKED-UP VERSION OF THE AMENDED CLAIMS

1. (Amended) A plasma processing method comprising the steps of:

placing a substrate inside a reaction chamber of a plasma processing system, a silicon dioxide film having been formed on the surface of the substrate;

introducing a fluorocarbon gas[, which contains carbon and fluorine and in which a ratio of carbon to fluorine is 0.5 or more,] into the reaction chamber, wherein the fluorocarbon gas contains at least one of C_4F_6, C_5F_8, and C_6F_6 gases; and

creating a plasma from the fluorocarbon gas and etching the silicon dioxide film with the plasma,

wherein a residence time τ of the fluorocarbon gas in the reaction chamber is controlled at a value greater than 0.1 sec and equal to or less than 1 sec, the residence time τ being given by P x V/Q, where P is a pressure (unit: Pa) of the fluorocarbon gas, V is a volume (unit: L) of the reaction chamber and Q is a flow rate (unit: Pa · L/sec) of the fluorocarbon gas.

4. (Amended) A plasma processing method comprising the steps of:

placing a substrate inside a reaction chamber of a plasma processing system, a silicon dioxide film having been formed on the surface of the substrate;

introducing a fluorocarbon gas[, which contains carbon and fluorine and in which a ratio of carbon to fluorine is 0.5 or more,] into the reaction chamber, wherein the fluorocarbon gas contains at least one of C_4F_6, C_5F_8, and C_6F_6 gases; and

creating a plasma from the fluorocarbon gas and etching the silicon dioxide film with the plasma,

wherein PxW_0/Q is controlled at a value greater than $0.8x10^4$ sec·W/m^3 and equal to or less than $8x10^4$ sec·W/m^3, PxW_0/Q being a product of a residence time τ of the fluorocarbon gas in the reaction chamber and a power density Pi of power applied to create the plasma, the residence time τ being given by PxV/Q, where P is a pressure (unit: Pa) of the fluorocarbon gas, V is a volume (unit: Pa · L/sec) of the fluorocarbon gas, the power density Pi being given by W_0/V, where W_0 is a magnitude (unit: W) of the power and V is the volume (unit: L) of the reaction chamber.

7. (Amended) A plasma processing method comprising the steps of:

placing a substrate inside a reaction chamber of a plasma processing system;

introducing a fluorocarbon gas[, which contains carbon and fluorine and in which a ratio of carbon to fluorine is 0.5 or more,] into the reaction chamber, wherein the fluorocarbon gas contains at least one of C_4F_6, C_5F_8, and C_6F_6 gases; and

creating a plasma from the fluorocarbon gas and depositing an organic film on the substrate using the plasma,

wherein a residence time τ of the fluorocarbon gas is controlled at 0.1 sec or less, the residence time τ being given by PxV/Q, where P is a pressure (unit: Pa) of the fluorocarbon gas, V is a volume (unit: L) of the reaction chamber and Q is a flow rate (unit: Pa · L/sec) of the fluorocarbon gas.

10. (Amended) A plasma processing method comprising the steps of:

placing a substrate inside a reaction chamber of a plasma processing system;

introducing a fluorocarbon gas[, which contains carbon and fluorine and in which a ratio of carbon to fluorine is 0.5 or more,] into the reaction chamber, wherein the fluorocarbon gas contains at least one of C_4F_6, C_5F_8, and C_6F_6 gases; and

creating a plasma from the fluorocarbon gas and depositing an organic film on the substrate using the plasma,

wherein PxW_0/Q is controlled at $0.8x10^4$ sec · W/m^3 or less, PxW_0/Q being a product of a residence time τ of the fluorocarbon gas and a power density of Pi of power applied to create the plasma, the residence time τ being given by PxV/Q, where P is a pressure (unit: Pa) of the fluorocarbon gas, V is a volume (unit: L) of the reaction chamber and Q is a flow rate (unit: Pa·L/sec) of the fluorocarbon gas, the power density Pi being given W_0/V, where W_0 is a magnitude (unit: W) of the power and V is the volume (unit: L) of the reaction chamber.